Assignment 12.3 p. 567 #9, 10, 11, 17, 49-56, 65a+b, 82

9) Termolecular reactions (3rd order) are rare because they require three molecules to collide with the proper orientation at the same time, which is highly unlikely.

Keep in mind that this does not mean we won't have three reactants, but when we see three reactants, that usually means there are multiple steps involved.

10) In order for H_2 and O_2 to react, they first need the activation energy needed to break their covalent bonds.

11) a. Increasing the partial pressure of H_2 would not effect k. It would increase $[H_2]$, which would increase the rate, but not k.

b. Increasing temp. would increase k. The same molecules will move faster and therefore collide more frequently and with more energy.

c. Using a catalyst will also increase k. It increases the rate without increasing either concentration.

17. Colliding molecules will not react if (a) they don't collide with sufficient energy to break the intramolecular bonds and (b) if they don't collide with the correct orientation to break those bonds.

49) a. Rate = k $[CH_3NC]$ b. Rate = k $[O_3]$ $[NO]$

c. Rate = k $[O_3]$ d. Rate = k $[O_3]$ $[O]$

50) Mechanism I: Rate = k $[H_2]^2$ $[NO]^2$

Mechanism II: Rate = k $[H_2]$ $[NO]$

Mechanism III: Rate = k $[H_2]$ $[NO]^2$

These come from the slow step

Only mechanism III is acceptable because it gives the correct rate law.

51) $C_4H_9Br \longrightarrow \cancel{C_4H_9^+}$

$\cancel{C_4H_9^+} + H_2O \longrightarrow \cancel{C_4H_9OH_2^+}$

$\cancel{C_4H_9OH_2^+} + H_2O \longrightarrow C_4H_9OH + H_3O^+$

$C_4H_9Br + 2H_2O \longrightarrow C_4H_9OH + H_3O^+$

Rate = k $[C_4H_9Br]$

Intermediates are $C_4H_9^+$ and $C_4H_9OH_2$

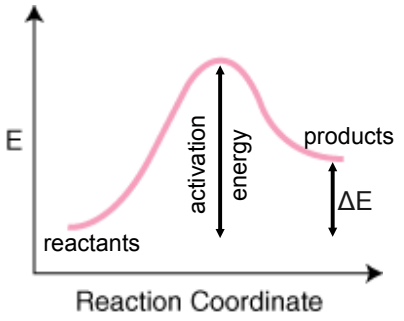
52) $\cancel{NO_2} + NO_2 \longrightarrow \cancel{NO_3} + NO$

$\cancel{NO_3} + CO \longrightarrow \cancel{NO_2} + CO_2$

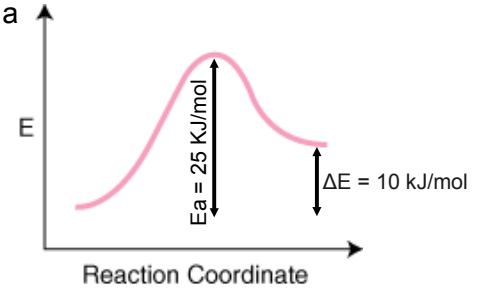
$NO_2 + CO \longrightarrow NO + CO_2$

Rate = k $[NO_2]^2$

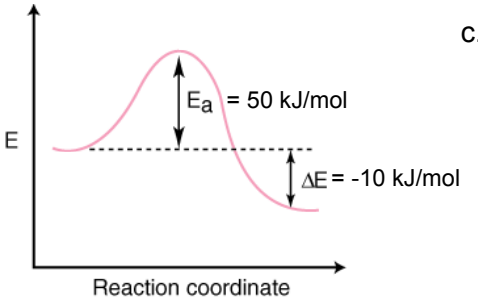
53)



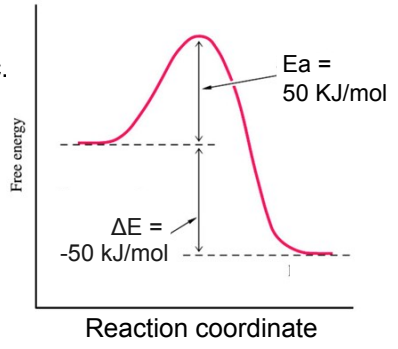
54) a



54) b.



c.



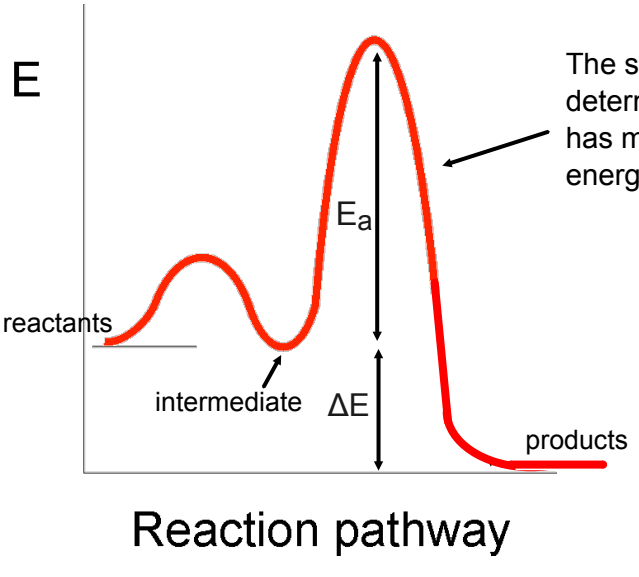
55) E_a for the reverse reaction is +341 kJ/mol.

56) If E_a is greater in the forward direction, it is endothermic. ΔE is positive.

65) a. NO is a catalyst because it is not consumed in the reaction.

b. NO_2 is an intermediate, because it is produced in the first reaction, but then consumed in the second.

82)



The second step is the rate determining step because it has much higher activation energy, so it will go slower.